DOCUMENT RESUME

ED 098 100 SO 007 870

TITLE	Teaching Resource Recovery in Social Studies. Resource Recovery Education Program.
INSTITUTION	National Association of Secondary School Principals, Washington, D.C.; National Center for Resource Recovery, Inc., Washington, D.C.
PUB DATE	74
NOTE	13p.; Related documents are SO 007 866-868
AVAILABLE FROM	National Association of Secondary School Principals, 1904 Association Drive, Reston, Virginia 22091 ($12.00 for kit, 20 discount on orders of five or more)
EDRS PRICE	MF-$0.75 HC Not Available from EDRS. PLUS POSTAGE
DESCRIPTORS	Class Activities; Community Study; *Conservation (Environment); Course Objectives; *Ecology; Economic Factors; Energy Conservation; *Environmental Education; Interdisciplinary Approach; Political Issues; Questioning Techniques; Resource Materials; Secondary Education; Social Problems; *Social Studies; Teaching Methods; *Waste Disposal

ABSTRACT

This guide, one component of the Resource Recovery Education Kit (see SO 007 866 for a description), contains ideas and activities for teaching about solid waste disposal in secondary level social studies classes. Among the course objectives are the following: (1) to explore the impact of our society on the problem of solid waste and the need for effective management; (2) to encourage student activities and involvement in environment conservation; (3) to examine technological developments which can reduce the problems and costs of refuse collection; and (4) to become aware of how local economic, political, and social problems are related to solid waste disposal and how local situations differ. Teaching strategies include having students conduct interviews, polls, and studies of the local community and classroom discussion. The guide consists of five major study units: (1) Solid Waste: A Growing Problem; (2) Collection and Transportation; (3) Disposal; (4) Resource Recovery; and (5) Solid Waste Management Systems. Objectives, student activities, questions for discussion and research, basic understandings to be developed, and instructional resources are provided for each unit. (Author/RM)

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Teaching resource recovery in SOCIAL STUDIES

RESOURCE RECOVERY EDUCATION PROGRAM

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I. SOLID WASTE: A GROWING PROBLEM

A. OBJECTIVES

1. To emphasize that everything in our environment is related to everything else and that, at least ecologically speaking, everything we do has an effect on someone or something else.
2. To lead students to realize that *everyone* contributes trash and garbage to our communities' solid waste stream and that, when properly managed (collected, transported, processed, and disposed of) these discards do not pollute. Improperly managed, these waste products represent what has been called the third pollution (after air and water).
3. To clarify aspects of our growing municipal trash and garbage challenge, particularly in terms of increasing volume, diminishing resources, and mounting management costs. To distinguish between municipal and other forms of solid waste (industrial, commercial, mineral, and agricultural).
4. To explore the impact of our increasingly populous, affluent, convenience-demanding, and health-conscious society on the problem of solid waste and the need for effective management.
5. To understand that litter, which occurs outside the solid waste collection system, represents a small but highly visible portion of our municipal solid waste load.
6. To encourage student activities and involvement that will help students plan and support action to protect the environment, conserve limited resources, and improve solid waste management.

B. STUDENT ACTIVITIES

1. To analyze environmental problems, it is important to understand ecology—the interrelationship among living things and nonliving things. Every community contains a complex of interacting systems related to land and water use. Identify some of the many purposes for which land and water are used in your town, county, or metropolitan area. Prepare a map of your community, showing major roads, business and residential areas, and bodies of water. As part of the map-making project, consider the following questions: What are the community's present land uses? Are natural resources wisely used? Are they well protected? How have natural features influenced the growth of your community? What man-made developments do you think have influenced the shape of your town? How does climate affect your community?
2. Choose a food item and trace its path from the land to the consumer. What land and water resources are necessary to produce this food item? Find out how the product is processed, transported, and stored. How many steps has it gone through? Now do the same with a durable product or container. Trace the steps from production to use:

raw material → production → consumer product ↓ use → disposal

What positive and negative effects are involved at each stage? What becomes of the product after it is used?
3. One of the main barriers to wise environmental management is that most people do not understand the problems, much less the solutions. Conduct interviews or an opinion poll to determine what the average student or citizen thinks about the nature and extent of the solid waste challenge. Prepare your questionnaire carefully and objectively in advance. Compare your findings with the information available on the topic. Are your subjects well informed, uninformed, or misinformed?
4. List the various factors that you believe afford Americans a high standard of living. Discuss the extent to which the items on your list contribute to a growing solid waste problem.
5. Consult an almanac or other source of information to secure facts comparing the standard of living in the United States with that in other nations. You may need to gather your data from several different sources, especially from government tables, charts, and graphs. Try to compare, also, the amount of solid waste produced in various countries.
6. Keep a diary for a week of your efforts to reduce the amount of pollution for which you are responsible.
7. Identify several environmental issues and problems. Make a collection of clippings, pictures, and other information related to these problems, their causes, and possible solutions. Be sure to include solid waste disposal as one of the issues.
8. Choose a favorite magazine and determine the amount of space devoted to solid waste and

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resource recovery in several recent consecutive issues. Then, if possible, make a similar study of the same magazine in several previous years. Compare the emphasis given to your topic in the different years. What conclusions can you draw from your findings?

9. Interview two or three people of your parents' generation and two or three of your grandparents' generation. Try to gather evidence as to the nature and extent of waste material produced in each generation. How has the composition of garbage changed since your grandparents' time? What major changes can be identified in food preservation, product selection, food preparation, and health protection?

10. Select an aspect of solid waste management (such as solid waste collection, disposal, energy, recycling) that interests you, and write to business, industry, or government sources for information on their activities in this area. Be careful to contact those sources that have direct involvement with the issues.

11. Contact, interview, and perhaps invite to your school several representatives of government, the local sanitation department, and businesses or industries related to solid waste management and resource recovery. (Use your telephone directory to identify city, county, or state offices, departments, or agencies involved in community solid waste handling and the solid waste challenge.)

12. As a starting point for an antilitter project, you should know the extent of the litter problem and some of the steps that must be taken to control it. Conduct a litter survey of your school, block, or neighborhood. Take photographs of litter accumulations and other places with inadequate trash disposal. Make the survey and photographs available to students and to school organizations as a basis for action.

13. Plan and conduct a campaign designed to influence others to adopt environmentally responsible behavior. One such project could be an antilitter or clean-up project for your community or a campaign to collect, return, and reuse or recycle material. (First, make certain that there are market outlets for recycled materials in your community.)

14. An important aid in changing the public's littering habits is intelligent use of communications media—school newspapers, public address systems, posters in school buses or libraries, slide shows, etc. Design an antilitter public awareness program using a variety of these media. Arrange for spot announcements to be read over school intercom systems. Include antilitter ads in school and PTA publications. Ask students in art class to make antilitter posters for school buses. Design art and photography displays to convince people that we ourselves, not always others, are personally responsible for the environment. Write a story for your newspaper describing current litter prevention activities in your community.

15. After each project is completed, make a final evaluation of what it accomplished. Such an evaluation can be most helpful in future projects—in avoiding past mistakes and highlighting successful techniques.

C. QUESTIONS FOR DISCUSSION AND RESEARCH

1. What are some of our major environmental problems? What are their causes?
2. What are the different kinds of pollution? What is the so-called third pollution?
3. What different kinds of materials are found in solid waste?
4. What is the magnitude of the national municipal solid waste problem?
5. What are some of the harmful and otherwise undesirable effects of traditional methods of solid waste disposal?
6. What are the principal components of municipal solid waste? How do they reflect our convenience-oriented, affluent standard of living? How do they contrast with the components of 50 and 100 years ago?
7. What is the average contribution per person to the municipal solid waste problem each day? Each year? How is this figure expected to change in the future? Why?
8. Is there adequate provision for disposal of litter in your community? What are the antilittering laws and how strictly are they enforced?
9. Refer to a graph or chart showing world population growth since 1650 A.D. How long did it take for the world population to double for the first time after 1650? The second time? The third? What conclusion can you draw from these figures?

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10. What is our nation's current population growth rate? At what rate is the production of goods and services in the United States growing? What conclusions and judgments can you make based on these facts?
11. What percentage of the world's population lives in the United States? What percentage of the world's resources are consumed here? What conclusions and judgments can you make based on these facts?
12. How do population size, rate of growth, and standard of living relate to pollution and solid waste problems?

D. BASIC UNDERSTANDINGS TO BE DEVELOPED

1. Environmental damage is the result of many complex, interrelated factors. Among them are air and water pollution, which are prominently on the minds of citizens everywhere. A third pollution is solid waste, which has only recently begun to be recognized as an environmental concern.
2. The term *solid waste* refers to everything that is solid and wasted rather than recovered by such processes as recycling, conversion, transformation, and reuse. The term *garbage* refers to the portion of solid waste (food scraps, etc.) that is likely to decompose or putrefy, whereas *trash* refers to the nonputrescible solid wastes (glass jars, tin cans, etc.) that do not include garbage.
3. Municipal solid waste is the waste (trash and garbage) generated by residential or commercial sources, transported by city or private collectors, and destined for the dump, incinerator, or landfill.
4. Improperly managed solid waste endangers human health and threatens the ecological support system we all depend on.
5. Litter is refuse that is improperly discarded or discarded in the wrong place. Litter can be controlled with more highway and street trash receptacles, with realistic state and local antilittering laws, and with responsible actions by everyone to prevent littering.
6. A higher standard of living demands a higher level of technological productivity; this in turn results in a greater volume of solid wastes. The number of people in the world is growing, and so is the percentage of people who can enjoy the products identified with a relatively high standard of living.
7. It is impossible for individuals to exist without affecting and disturbing the environment to some extent. Each person contributes to environmental pollution and solid waste. Our goal should be to minimize environmental damage, upgrade solid waste management, and discourage resource depletion. Individuals need to develop and help others to develop a sense of personal responsibility for what happens to our environment and quality of life.

E. INSTRUCTIONAL RESOURCES

1. Read Topic II on collection and transportation in the section "A Survey of Resource Recovery" in the students' booklet.
2. Refer to the article "Can Free Enterprise Speed Up Our Garbage Collection?" listed in Instructional Resources.

II. COLLECTION AND TRANSPORTATION

A. OBJECTIVES

1. To be aware of how trash and garbage are handled after they have been left to be hauled away. To know how they are conveyed and what becomes of them.
2. To understand that a disproportionate amount of money (nearly 80 percent of community refuse expenditures) and manpower is expended on the collection and transportation of solid wastes alone.
3. To be aware of how outmoded collection methods add to municipal costs and health and environmental problems.
4. To examine recent technological and managerial developments that make it possible to reduce the problems and costs of refuse collection.

B. STUDENT ACTIVITIES

1. Investigate the methods used in your community for collecting trash and garbage and transporting them to a disposal site. Remember that in many communities there are private companies as well as municipal agencies that collect and haul household or commercial refuse. Take photographs of these operations and use them in preparing a bulletin board display.
2. Visit your local solid waste management office (whether a city sanitation agency or private hauling company) to obtain information about the amount of solid waste collected locally, the major

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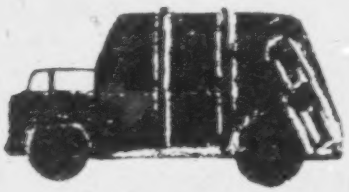
materials contained in the waste, and the cost of handling this refuse.
3. Make a survey of commercial businesses and industries in your area regarding the nature and amount of their solid waste. Find out how this waste is handled and whether any of it is recycled into the making of new products.
4. Gather information on one of the newer systems for solid waste collection and transportation. Prepare a report or a display to share your information.
5. Prepare a report on the comparative advantages of the different new systems for collecting and transporting municipal solid waste. Topics to be considered include the requirements of cost, labor, and equipment. Discuss the advantages and disadvantages of each of these technological advances for your community.



C. QUESTIONS FOR DISCUSSION AND RESEARCH

1. How is municipal solid waste collected and transported in your town or county?
2. What have been the leading improvements and refinements of the municipal waste collection process in your area during the past 10 to 20 years? Does everyone in your community enjoy these benefits, or are they unevenly distributed and shared?
3. How are the problems of collecting and transporting municipal solid waste related to environmental pollution? What are the hidden costs of improper solid waste handling?
4. What is the national cost for handling municipal solid waste? What factors have contributed to the steady increase in this cost?
5. How can present methods for collecting and transporting solid waste be improved?
6. What are some of the most promising methods recently developed for the collection and transportation of municipal solid waste?
7. Which of the newer developments in the collection and transportation of municipal solid waste seem to hold the greatest promise for your local area? Why?
8. To what extent does municipal solid waste management fall within the realm of private enterprise? Within public (governmental) enterprise? Are garbage and trash in your community removed by private or public enterprise?
9. Historically, individual towns and cities have been responsible for collection and disposal of their solid wastes. Consequently, a number of communities within a region can have independent waste-handling systems. Find out if your community and nearby towns and cities have separate systems, and discuss the advantages and disadvantages of this jurisdictional arrangement.

D. BASIC UNDERSTANDINGS TO BE DEVELOPED

1. Present methods and equipment for collecting and transporting municipal solid waste have been greatly refined in recent years. The overall process, however, is still often antiquated, inefficient, and expensive because improvements have not been adopted.
2. Municipal solid waste management usually encompasses collecting, transporting, processing, and recovering resources and disposing of solid waste. Although some 80 percent of this total cost is spent on collecting alone, it is now possible in many communities to reduce expenses and increase efficiency by using the latest advances in technology.
3. Methods and equipment for collecting and transporting solid waste can be improved through a variety of techniques and approaches, especially in the areas of collection routing, equipment utilization, crew training, occupational safety, and household refuse handling.
4. Several systems have been developed that show promise for improving solid waste collection and transportation. Among these systems are one-man collection trucks with automated equipment to pick up refuse containers, trucks equipped to shred as well as compact waste, computerized routing of collection trucks, transfer stations to expedite waste handling, and pneumatic tube collection to reduce or eliminate the number of trucks.

E. INSTRUCTIONAL RESOURCES

1. Read Topic 1 on solid waste in the section "A Survey of Resource Recovery" in the students' booklet.

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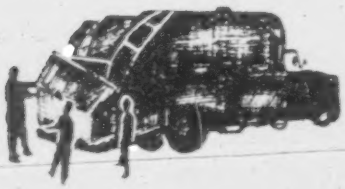
2. Refer to the article "Mission 5000, A Citizens' Solid Waste Management Project," listed in Instructional Resources.



III. DISPOSAL

A. OBJECTIVES

1. To emphasize how in most cases the two primary methods of disposal (open dumping and burning; substandard incineration) cause pollution, add to the costs of health and environmental protection, and waste valuable resources.
2. To become aware of how local economic, political, and social problems are related to solid waste disposal and how local situations differ.
3. To learn about improved methods for reducing waste volume and disposing of the residue (sanitary landfill, controlled incineration, pyrolysis, etc.).

B. STUDENT ACTIVITIES

1. Investigate the means of disposing of the trash and garbage collected locally. Visit your local dump, incinerator, sanitary landfill, or composting operation. Collect information on its operation (how much refuse is processed, number of personnel, type of equipment, etc.). Make photographs and use them in preparing a report or a bulletin board display.
2. If your town or county still uses an open dump, try to determine what steps are being taken to convert to some other means of handling solid waste. Find out the issues involved and the expected cost of conversion.
3. If your town or county uses an incinerator for solid waste disposal, find out how pollution-free the operation is. If it creates pollution, find out if there are plans to upgrade the facility's pollution control equipment. What kinds of devices are needed, and at what estimated costs? If modernization is not practical, learn what alternatives are being considered.
4. If your town or county uses a sanitary landfill, find out how it is operated. Is solid waste compacted and covered each day, or is the disposal site really a kind of open dump?
5. Is there a composting operation in your community? If so, learn what you can about its operation and product marketability.
6. Investigate the improved methods for dealing with municipal solid waste (pyrolysis, controlled incineration, sanitary landfill, etc.) and present your information in class.
7. Talk with local government officials or representatives about present laws and their enforcement with regard to solid waste management. Determine what new laws or enforcement procedures are needed. What factors have hastened or blocked their adoption?

C. QUESTIONS FOR DISCUSSION AND RESEARCH

1. Before you began to study the solid waste challenge, what did you think happened to your discards? Did you really think about the subject at all? Based on your research, tell what becomes of municipal solid waste once it is collected.
2. In your community, what proportion of municipal solid waste is disposed of in an open dump? An incinerator? A sanitary landfill? By composting? Are valuable natural resources from the municipal solid waste stream salvaged for recovery? Are the methods used economically and ecologically sound?
3. How is solid waste disposal related to environmental pollution? What are the advantages and disadvantages of the open dump, the incinerator, the sanitary landfill, and composting as means of dealing with solid waste?
4. In what ways does the sanitary landfill represent a negative approach to the solid waste problem? In what ways does it represent a positive approach?
5. In what ways does the incinerator represent a negative approach to the solid waste problem? In what ways does it represent a positive approach?
6. What are some of the recent improvements in the methods of disposing of municipal solid waste? Which of these might best be adapted to your local area, and why are they most suitable?

D. BASIC UNDERSTANDINGS TO BE DEVELOPED

1. Man's resources are ultimately returned to the earth. After these resources are consumed by man and discarded, they are disposed of in a variety of ways—primarily open dumping and burning, sanitary landfilling, and incineration. Each of these methods has certain advantages and disadvantages.
2. Most of the methods commonly used to dispose of municipal solid waste tend to create health hazards, add to environmental degradation, and waste valuable resources.

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3. In addition to the more obvious costs of waste removal, there is often a series of hidden costs, such as rodent and insect infestation, land value depreciation, and air and water pollution.
4. An open dump is a place where solid waste is dumped and left to decay. Open dumping has certain advantages: It is the least expensive disposal method, and it requires the least skill and manpower to operate.

Open dumping also has many serious disadvantages: It damages good land; it smolders and creates a fire hazard; it attracts flies, rodents, and other disease-carrying pests; it pollutes the air and water sources; it produces bad odors; it represents an eyesore—a kind of visual pollution; and it wastes valuable resources.
5. Incineration is enclosed burning. There are many advantages in incineration: It reduces the volume and the weight of solid waste; it removes most organic (combustible) matter from the waste; it requires less land area than open dumping or sanitary landfills; it requires little sorting of the solid waste; it can operate in any climate or weather; it can adjust fairly easily to variations in the volume of waste; it can be used to produce heat, steam, and electrical energy; it can be located close to the sources of refuse.

Incineration also has disadvantages: Valuable resources are lost; some residue remains for further disposal; it is expensive to construct, operate, and maintain properly; auxiliary fuel is needed if the refuse is wet; air pollution is usually created unless costly antipollution devices are installed.
6. A sanitary landfill, if properly engineered and operated, involves dumping, compacting, and burying refuse under several inches of soil each day. It is a simpler, more hygienic, and more complete method for waste disposal than either an incinerator or an open dump. The advantages of a sanitary landfill are that it is relatively inexpensive to start if land is available; it is inexpensive to operate, provided that it is located close to the source of refuse and that transportation is not too costly; there is no burning or unpleasant odor, littering, breeding of vermin, or pollution of air or water sources; and it can make undesirable land valuable for recreational and commercial uses.

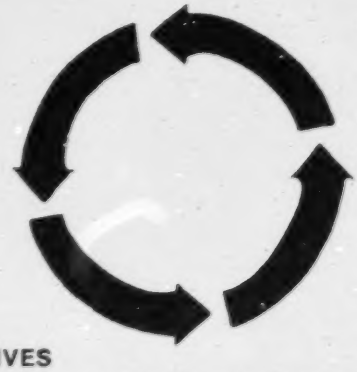
The disadvantages of a sanitary landfill are that the land may be costly, the location may be such that transportation costs are high, there may be limitations on the use that can be made of the filled land site, and valuable resources are wasted.
7. Composting is the use of biological decomposition to reduce organic refuse to inert, humuslike material. This method is widely used in Europe, but in our country it has generally proved to be unprofitable as a commercial venture, and it consumes only a small fraction of our municipal solid waste. The advantages of composting are that it returns organic matter to the earth, thus improving the soil (especially its water-retention ability); it reduces the volume of organic wastes by 40 to 60 percent; it does not pollute; and it can be enriched (for example, with the addition of treated sewage sludge) to improve its nutrient value.

The disadvantages of composting are that it uses only the organic portion of the solid waste stream, prior sorting is required to remove inorganic materials, it is an expensive process to start and operate, neighbors often object, and there is not a sufficient market for the compost at this time.
8. The open dump is an unacceptable method of waste disposal. Incineration can provide an effective means of volume reduction, but it is a costly process and is acceptable only if operated as a nonpollutant. Since there will always be some residue from incinerators and from emerging resource recovery systems, the sanitary landfill—properly engineered and operated—is the only acceptable means of final disposal.
9. The modification and improvement of solid waste disposal or processing systems involve problems that are partly technical and partly economic, political, and social.

E. INSTRUCTIONAL RESOURCES

1. Read Topic III on disposal in the section "A Survey of Resource Recovery" in the students' booklet.
2. Refer to the publication "Municipal Refuse Disposal," listed in Instructional Resources.

IV. RESOURCE RECOVERY



A. OBJECTIVES

1. To develop the understanding that through resource recovery we can utilize materials from solid waste and thus conserve depletable resources for the future.

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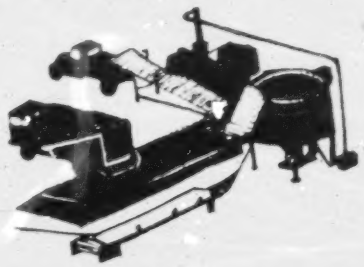
2. To understand that municipal solid waste is a vast national resource of materials and energy and that sufficient technology already exists to recover a much greater segment of these precious resources than we are now extracting.
3. To be familiar with the most significant resource recovery techniques and systems that are now available or in development.
4. To understand that although proper solid waste management can turn a national problem into an economic opportunity, lasting resource recovery is possible only if the value from its use exceeds the cost of separation or processing. The challenge is largely economic, and therein lies both the problem and the solution.

B. STUDENT ACTIVITIES

1. Most communities have commercial scrap dealers who collect or buy scrap metal, paper, glass, fabrics, and other materials for sale directly to manufacturing industries. Besides this "secondary materials" industry many municipalities have voluntary collection or recycling centers organized by ecology-minded volunteer groups and assisted by the industries involved. Visit one or more of these centers and find out how various materials are collected, what type of processing is done at the facility, who buys these materials and at what prices, what demand there is for the collected materials, etc.
2. Most communities have some manufacturing plants in the area. Call or visit one or more of these plants to find out what use, if any, is made of the scrap and recycled materials.
3. Contact a local voluntary collection or recycling center to find out what materials are collected (bottles, cans, newspapers, etc.), what it costs to operate the facility, how much voluntary help is given and what services have to be bought, whether materials are picked up at homes or delivered to the center by householders, how many materials are collected and sold, etc.
4. Plan a collection of salvageable waste materials. First contact the salvage dealers and the local glass, can, and paper companies to see if markets for the materials are available locally.
5. Determine what collection points exist in your geographic area for the return of various scrap materials. Include scrap or junk dealers and community and industrial recycling centers.
6. Write letters to the manufacturers of certain products (cans, bottles, paper, etc.) asking for information on the recycling of their products.
7. Investigate the newer methods and systems for recovering various resources from municipal solid waste. Some of these are in an experimental or pilot stage, and some are actually operational. Which ones seem applicable to your geographic area and why are they most suitable?
8. Find examples of how one municipal waste component can be recovered by reuse, recycling, conversion, or transformation. Prepare a bulletin board on resource recovery of this material.
9. Plan and conduct a Resource Recovery Fair, using models, displays, or charts to communicate information, develop interest and concern, and encourage environmentally responsible behavior.
10. Plan a bulletin board display on resource recovery, using one of the following topics:
a. Solid Waste—Urban Ore from Our Discards.
b. Closing the Circle.



11. Select one of the recoverable resources (glass, paper, iron and steel, aluminum, plastics, rubber, mixed organic wastes, etc.) and investigate present and potential ways of reusing, recycling, converting, or transforming that particular resource. Which methods seem most promising? Why?
12. Compile a list of products that traditionally contain reused materials and a second list of products in which recycled materials are starting to be used. Develop a bulletin board display to demonstrate the progress made in reuse.
13. Find out if your area has municipal incinerators for burning solid waste. If so, find out whether the incinerator is designed to produce heat, steam, or electricity as a salable by-product of its operation.
14. Consult with students or teachers in science or industrial arts to plan and carry out a project for making new paper from wastepaper and new glass from glass scraps or waste.
15. Consult with students or teachers in science or industrial arts about the fuel value of paper, plastic, and rubber in solid waste incineration. Plan and carry out an experiment to demonstrate your findings.
16. Conduct a survey of a number of surrounding towns and cities to determine how many, if any, communities are actually participating in resource recovery programs. Are resource recovery programs planned? Will local power companies use refuse as fuel?

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C. QUESTIONS FOR DISCUSSION AND RESEARCH

1. What are the basic differences between solid waste disposal and resource recovery?
2. How is resource recovery related to the depletion of natural resources?
3. What are the major methods for recovering resources?
4. What is the difference between conversion and recycling of waste materials?
5. What is a "front end" resource recovery system?
6. What is a "back end" resource recovery system?
7. What are the basic problems related to recovering resources from mixed municipal solid waste?
8. What materials are most easily recovered from mixed waste? Why? Which are more difficult to recover? Why?
9. What recovered resources can be reused without recycling? Give examples.
10. What recovered resources can be recycled to make new products? Give examples of the new products that can be made after recycling.
11. What recovered resources can be converted into new products? Give examples of the new products resulting from the conversion of the original material.

D. BASIC UNDERSTANDINGS TO BE DEVELOPED

1. As long as our society demands the benefits of modern packaging, we must assume the responsibility that goes with those benefits. That responsibility is to help reclaim and reuse packaging materials by means of resource recovery.
2. Disposing of solid waste in dumps, incinerators, and landfills represents a loss of both irreplaceable (nonrenewable) and limited (renewable) resources that could otherwise be recovered. The present system of use and discard must be changed in order to conserve raw materials, conserve land space, protect the environment, save the taxpayers' money, and reduce the amount of waste our environment must absorb.
3. *Resource recovery* is a term used to describe the extraction and utilization of materials and values from the solid waste stream. The list of specific examples of resource recovery is almost limitless. Glass can be reused or recycled into new glass or into building materials; metals can be used to make new metals; paper can be reprocessed into new paper products or burned to produce steam or heat and to generate electricity. Organic materials can be used to make compost or converted into storable fuels.
4. Reuse of salvaged raw materials is not new. Although the idea of resource recovery from municipal refuse is fairly recent, industry itself has been the primary recycler of its own solid waste. Sometimes plant scrap is thrown right back into the industrial hopper, usually to be melted down and go through the manufacturing process again. The by-products of manufacturing are usually purchased by dealers, processed for reuse, and sold back to the original manufacturer.
5. Another important form of resource recovery is the citizens' recycling movement. This is a volunteer-sponsored effort to collect used bottles, cans, and paper at community centers to sell to private companies. Part of the proceeds from recycling are returned to the community.
6. For some manufacturing (certain grades of steel, aluminum, glass, and paper, for example), the use of a combination of new materials and scrap materials is advantageous and desirable. Often the use of waste products can ease the manufacturing process, improve the final product, and lower the cost of manufacturing.
7. Resource recovery from mixed municipal garbage and trash is a relatively new concept. A problem in accomplishing this is that collecting, sorting, and classifying contaminated mixed refuse have not been attempted on a large scale. Before materials can be recovered on a major economic scale, answers must be found to the complex questions of costs, markets, technology, and social considerations.
8. The inorganic materials in solid waste represent the most valuable ingredients in our refuse. Since these metals, minerals, and glass are nonrenewable, limited resources, it is desirable to recover them for use like raw materials in the manufacture of new products. This use of materials recovered from waste is called recycling.
9. In addition to using recovered resources as raw materials in recycling, certain organic waste materials (paper, plastics, and rubber, for example) may be used as fuel for the production of heat, steam, and electrical power. This use is called conversion.

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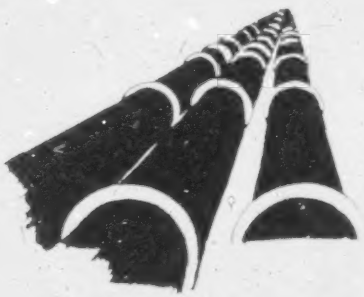
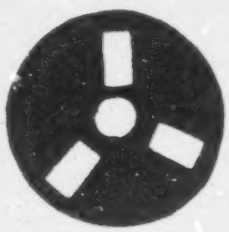
10. Municipalities planning a recycling operation, as well as private converters of municipal trash, would be well advised to know in advance who will be the customers for the metal, paper, glass, and compost produced from the recycling operations. Along with the obvious need to develop new and larger markets, it is usually necessary to find customers near the treatment plant in order to minimize shipping charges.
11. Ultimate solutions to solid waste management problems will include refinements of several methods, among them incineration, landfilling, composting, and resource recovery. The basic long-range solution for many communities, however, will be resource recovery.



E. INSTRUCTIONAL RESOURCES

1. Read Topic IV on resource recovery in the section "A Survey of Resource Recovery" in the students' booklet.
2. Refer to the article "Machinery for Trash Mining, Part II," in Instructional Resources.

V. SOLID WASTE MANAGEMENT SYSTEMS



A. OBJECTIVES

1. To understand that solid waste management must be dealt with through a total systems approach comprising the steps of home collection, separation, recovery, and conversion and that several promising systems are already in operation in addition to those in development.
2. To understand that although new systems are emerging, no single solution is likely to be adaptable to every situation.
3. To identify and remove the stumbling blocks that prevent us from realizing wide-scale resource recovery today.
4. To understand that technological problems may be solved more readily than economic ones.
5. To determine whether your community has a solid waste management plan that is far-reaching and comprehensive rather that shortsighted and piecemeal.

B. STUDENT ACTIVITIES

1. Choose some invention or technological development of the past and investigate the public reaction to its introduction. What social, political, or economic problems were created?
2. Develop a checklist of criteria for use in comparing and evaluating possible solutions to an environmental problem. (For example, which is least expensive? Safest? Quickest?)
3. Imagine some wonderful new invention (such as a pollution-free automobile powered by a fuel cell with electricity generated by a mixture of hydrogen and oxygen). What businesses, industries, and individuals might be unhappy as a result of this invention? Why might they feel this way? Relate these answers to some of the complexities of implementing resource recovery techniques.
4. List as many possible and partial solutions to solid waste management as you can. Which ones do you consider more desirable, and which ones are less desirable? Give reasons to support your answers.
5. Investigate one of the newer processes or systems for collecting, transporting, or processing solid waste. If this process or system should be utilized in your geographic area, which businesses, industries, and people might be adversely affected and why? Which might be favorably affected and why?
6. Gather information on the budget expenditures of your local government (city or county) and prepare a circle graph to show the percentage spent for each major item. How does solid waste management rank in terms of spending? What are the sources of revenue supporting refuse handling (such as city taxes or individual user charges to each household)?
7. Investigate the separate and coordinated activities of local, state, and federal governments in the areas of solid waste management and resource recovery in your community.
8. Make a study of what the role of local and state governments have been, are, and should be in solid waste control. Try to obtain copies of local and state sanitation codes, litter ordinances, and other environmental protection legislation. Are

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these antipollution laws effective and enforceable? Are penalties realistic? Make a similar study of federal legislation.

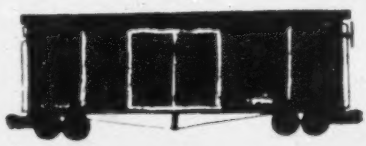
If some of these measures have been enacted recently, how have they affected your community's solid waste management system? Has an incinerator recently been declared a pollutant and, therefore, ruled illegal? Is a dump being closed? Will additional money be required to meet new environmental standards?

9. After making a study of the legislation, draw up an improved set of litter control or environmental protection laws for your municipal area. Design a community support program for the new regulations.

10. Work with students and teachers in science and industrial arts to develop a model for a solid waste management system. Consider including each of the following aspects: collection, transportation, separation, incineration, landfilling, reuse and recycling, and conversion and transformation of several materials.

C. QUESTIONS FOR DISCUSSION AND RESEARCH

1. What are some of the economic problems related to resource recovery? Some of the social and political problems?
2. Why must we make choices and establish priorities regarding our use of resources?
3. How are the supply of and demand for resources related to manufacturing costs and consumer prices?
4. How might governmental action influence the economics of resource recovery in the areas of supply, demand, and price?
5. Why is it inevitable that the public will ultimately have to pay for a clean environment?
6. What is meant by a total systems approach to the solid waste problem?
7. Would resource recovery be a worthwhile venture for your community—one that would help to prevent pollution, conserve valuable resources, and improve the quality of life for citizens?
8. Why might the best solution to solid waste problems differ from place to place? From time to time?
9. How might an action designed to solve one problem actually create or contribute to other problems?
10. What are some activities of government (local state, and federal) designed to help solve the solid waste problem?



11. What areas of solid waste management have thus far received greatest attention from government?
12. Why might the eventual solutions to solid waste problems include some continued use of incinerators and landfills? How will the future use of incinerators and sanitary landfills differ from their use at present?
13. In what ways is the success of a resource recovery program related to people's attitudes and values? How are education and public opinion important to a resource recovery program?
14. What actions can individuals, groups, and government take to increase the reuse and recycling of materials?
15. What are some of the organizations and agencies concerned with environmental problems, such as pollution and solid waste management?

D. BASIC UNDERSTANDINGS TO BE DEVELOPED

1. No one answer or set of answers will solve the solid waste problems of all communities. Solutions vary according to the conditions existing in each community.
2. The causes of and solutions to pollution and solid waste problems are only partly technological. They are also economic, social, cultural, and political.

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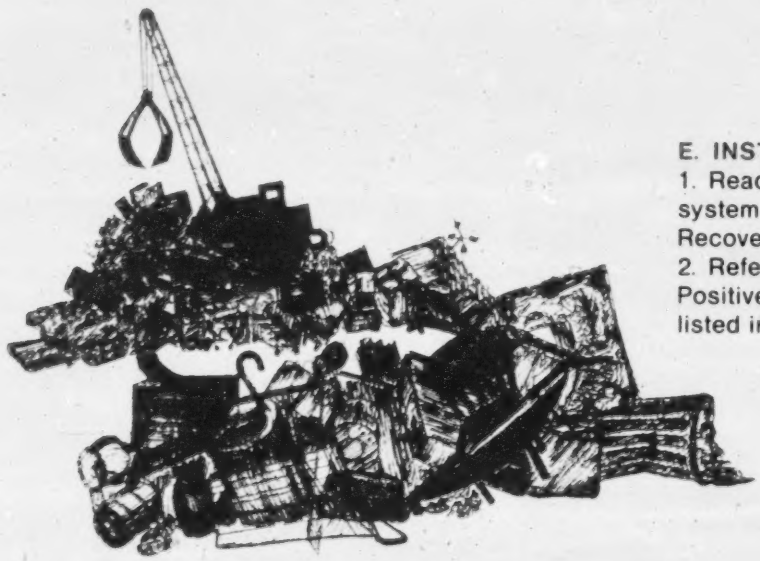
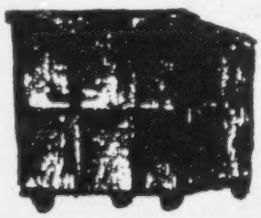
3. Realistic approaches to solving solid waste problems include shared responsibility among individuals, private enterprise, and government at all levels; cooperation among all interested groups— scientific, technological, sociological, economic, and political, and a variety of options for collection of wastes, separation of materials, resource recovery, and disposal of residue.
4. Each municipality should have a comprehensive plan for handling and disposing of its trash and garbage in a manner that is environmentally sound as well as economical and efficient.
5. Despite the tremendous current cost of waste disposal, taxpayers generally have denied public officials the money to develop improved solid waste management systems. We must find both money and ways to initiate and support community resource-recovery programs.
6. The long-range approach to solid waste control should include improved waste management practices as well as the recovery of valuable resources and the wise disposal of irreducible residues.



7. The long-range solution to the problem of solid waste disposal will probably evolve from open dumping to the use of sanitary landfills and improved furnaces, and later to more complex systems for recycling and recovery. These recycling and recovery systems may involve continued use of incinerators (with certain organic materials used as fuel for producing heat or electricity) and of sanitary landfills (for the residue that remains after various resources have been recovered).
8. In the average community, solid wastes are often mismanaged, and the public does not comprehend the difficult problems involved. Better understanding of the issues can be achieved through education, advertising, and governmental action to help arouse or influence public opinion.
9. Solutions to the pollution and solid waste problems depend on the actions, choices, and decisions that each person makes, as well as on citizen involvement and interest in civic affairs.
10. Governments (local, state, and federal) will remain active in the areas of environment, pollution, and resource recovery. Two possible directions that federal involvement may take are the regulatory approach, whereby standards are established and enforced, and the incentive approach, whereby laws and measures are established to encourage industry, municipalities, and even individuals to engage in the recycling or return of materials.



E. INSTRUCTIONAL RESOURCES

1. Read Topic V on solid waste management systems in the section "A Survey of Resource Recovery" in the students' booklet.
2. Refer to the article "Resource Recovery, A Positive Approach to the Solid Waste Problem," listed in Instructional Resources.